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ABSTRACT

Assuming the relevance of the linear precedence to the scope interpretation of adult Mandarin, this study investigated the development of this principle in Mandarin-speaking children, with a view to providing a basis for further study of parametric variation. Three kinds of sentences were examined, all of which contained mutually commanding Quantifier Noun Phrases (QNP) that do not c-command each other. The three sentence types also differed with respect to the possibility of scope ambiguity. The findings reveal that quantifier order is distinguished by Chinese children by age 6, and that the linearity principle for scope interpretation is firmly established by age 7. There is also evidence to suggest that if scope ambiguity is entirely due to the operation of the thematic hierarchy, the latter scope interpretation principle is acquired late. Data on "Ba"-sentences also indicate that construction-specific effects related to definiteness may affect subjects' judgment of quantifier scope. (VWL)

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ED 364 069

The Role of Linear Order in the Acquisition of Quantifier Scope in Chinese*

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1. *Introduction*

In the linguistics and philosophy literature, it has long been observed that a salient property of quantifier noun phrases (QNP) such as *a story, two strings, every child* lies in their ability to exhibit relative scope (cf. e.g. Quine 1960, Lakoff 1971, Keenan 1971).[1] If a QNP falls within the scope of another, the former may be referentially dependent on the latter. This can be illustrated by the English sentence (1), which contains two QNPs - *a story* and *every child*. Depending on which QNP falls within the scope of the other, (1) can have two interpretations, given in (2a) and (2b).

(1) *A story* was read to *every child*.
(2) a. There is a x = story such that for all y = child, x was read to y.
b. For all y = child, there is a x = story such that x was read to y.

In the interpretation (2a), *every child* is within the scope of *a story*; the former is said to have narrow scope, while the latter has wide scope: it was the same story that was read to every child. In the reading represented by (2b), where *a story* has narrow scope, the choice of referent depends on the choice of the child: different stories may have been read to different children.

The question as to how children of various ages interpret the relative scope of quantifiers is of considerable interest from the standpoint of learnability. The representation of scope requires theoretical constructs such as operators (e.g. there is a x, for all y) and variables (e.g. x, y), as well as well-formedness conditions governing the binding of variables.[2] It seems plausible to assume that abstract constructs such as operators and variables are not learned inductively, but are part of the initial state of the child. In other words, they might be among the substantive universals of Universal Grammar (UG). Following the spirit of Fodor (1980)'s argument, it is clear that children who do not possess the linguistic concepts of operators and variables would find it impossible to learn whether the language they are exposed to (e.g. English) displays scope ambiguity. This is because given a sentence like (1), children first of all need to have the means of representing the two scope interpretations of the sentence before they can detect scope ambiguity. The representation of scope possibilities presupposes the postulation of operators and variables in the first place.[3]

A further point that can be made is that even though the

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variable-binding property of QNPs may be endowed as part of UG,[4] it is possible that these innate properties are not available to the child at the outset. Rather they manifest themselves at a later stage as the child matures. As Borer and Wexler (1987) have observed, while children's grammar may be consistent with UG principles at all stages of its evolution, it is conceivable that some UG principles are not realized at particular stages because of maturational factors. It remains, therefore, for empirical investigations to ascertain whether children indeed grasp the scope property of QNPs early on in their development.

The acquisition of quantificational scope also deserves attention because the principles determining scope interpretation differ from one language to another. Quantificational scope is an area of grammar that shows parametric variation. A striking contrast between Chinese and English is that generally speaking, English permits scope ambiguity much more freely than Chinese. In English, the relative scope of QNPs in a clause is generally not uniquely determined by the relative position of the QNPs at S-structure.[5] Thus, it is not the case that in (1), the structurally superior subject QNP *a story* always has wide scope over the prepositional object QNP *every child*. Rather, either QNP may have wide scope. In Chinese, however, as first observed by S.F. Huang (1981), a strong isomorphism exists between S-structure and Logical Form (LF).[6] A subject QNP invariably has scope over an object QNP, as shown by (3). The sentence cannot have the interpretation (3b) where the object QNP *meige xuesheng* 'every student' has the subject QNP *yige jingcha* 'a cop' within its scope.

(3) a. Turan, yige jingcha zhuazou le meige xuesheng
suddenly one-CL cop arrest ASP every-CL student
"Suddenly, a cop arrested every student"

b. There is a x = cop such that for all y = student, x arrested y
c. *For all y = student, there is a x = cop such that x arrested y

Some languages may use linear precedence as a principle for scope interpretation, so that if QNP A precedes QNP B at S-structure, then A has scope over B at LF. As we will argue later, this is essentially the relevant principle for Chinese. For other languages such as English, linearity may be irrelevant. The fact that a QNP A precedes another QNP B at S-structure does not mean that the only scope interpretation is the one with A having wide scope. Given these crosslinguistic facts, one may assume that the parameters for the determination of scope may take on different values (e.g. different syntactic relations) across languages.

If languages vary in how quantifier scope is determined, how do children learn the scope interpretation principles of their native language? What initial principles do they adopt? Do they assume free scope order or do they regard scope order as given directly by the relative positions of the QNPs at S-structure? These are intriguing learnability issues which can

only receive satisfactory answers when acquisition data is available for a variety of languages governed by different scope interpretation principles. The present research is intended to be a contribution to this line of inquiry. We will demonstrate empirically that linearity must be a strong principle assumed by Mandarin-speaking children in their understanding of scope. Below we outline the principles for determining quantifier scope in adult Mandarin Chinese before turning to the experimental study.

2. *Quantifier Scope in Mandarin Chinese*

The scope principles for Mandarin Chinese which we adopt for the experimental investigation are given in (4) (cf. J. Huang 1983, Aoun and Li 1987 for alternative analysis):

(4) Suppose A and B are QNPs, then
  a. if A asymmetrically commands B at S-structure, A has scope over B at Logical Form (LF) (A *commands* B if neither dominates the other and the first S node dominating A also dominates B);
  b. if A and B command each other and A precedes B at S-structure, A has scope over B at LF.

The first principle captures the clauseboundedness of the effect of quantification. Intuitively, a QNP cannot escape from its own clause to have scope over another QNP in a higher clause. Figures 1a and 1b illustrate structures where QNP_2 asymmetrically commands QNP_1. In Figure 1a, QNP_1 occurs within a sentential subject; in Figure 1b, QNP_1 is located within a relative clause modifying a subject NP. In both figures, QNP_2 commands QNP_1 since the first S-node dominating QNP_2 is S_0, which dominates S_1, the first S node dominating QNP_1. However, QNP_1 does not command QNP_2 because S_1 does not dominate S_0. Examples of these structures are given in (5-6).

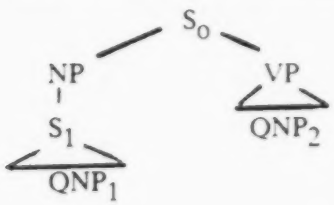

Figure 1a

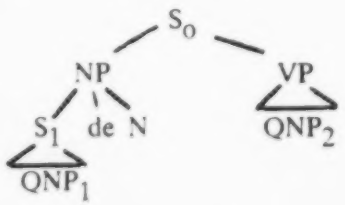

Figure 1b

(5) a. [xili jinnian qing le sange zhujiao]
department-in this-year hire ASP three-CL teaching-assistant
dui meige laoshi dou you haochu
to every-CL teacher all have benefit
"(the fact) [that the department hired three teaching assistants] this year is beneficial to every teacher"
  b. For all y = teacher, the fact that there are three x = teaching assistant such that the department hired x is beneficial to y.

c. *There are three x = teaching assistant such that for all y = teacher, the fact that the department hired x is beneficial to y.

(6) a. [shujia kan le yibai ben shu] de tongxue
summer read ASP one-hundred CL book NOM classmate
dedao meige laoshi de chengzan
obtain every-CL teacher NOM praise
"Students [who read a hundred books in the summer] obtained the praise of every teacher."

b. For all y = teacher, students such that there are a hundred x = book and students read x obtained the praise of y.

c. *There are a hundred x = book such that for all y = teacher, students who read x won the praise of y.

In (5), QNP_2 is *meige laoshi* 'every teacher', while QNP_1 is *sange xuesheng* 'three students'. In (6), QNP_2 is also *meige laoshi* 'every teacher, and QNP_1 is *yibai ben shu* 'a hundred books'. By our scope principle (4a), only QNP_2 may have wide scope in both sentences. This is borne out by the data. Sentence (5) cannot be understood as "there are three teaching assistants such that for each of them, the fact that the department hired him/her is beneficial to every teacher". Likewise, (6) does not mean "there are a hundred books such that for each of them, student who read it obtained the praise of every teacher." The fact that asymmetrical command is the relevant principle for deciding the relative scope of QNPs in separate clauses can also be seen from the fact that linear order fails to play any role in these cases. Although QNP_1 precedes QNP_2 in (5-6), it is QNP_2 that takes wide scope.

Linear order is relevant for scope interpretation only when asymmetrical command does not obtain, as stated in (4b). If two QNPs command each other, the one that precedes will have wide scope. Below we examine four types of structures in which the QNPs mutually command. For all these cases, the linearity principle makes the correct prediction. Consider Figure 2, which shows a QNP in subject position (QNP_1) and another QNP in object position (QNP_2). A sentence whose core structure coincides with that in this figure has been given earlier in (3).

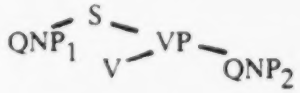

Figure 2

The scope principle (4b) says that QNP_1 will have scope over QNP_2. This is consistent with the facts of the unambiguous sentence (3), in which only *yige jingcha* 'a cop' may have wide scope. While on the surface (4b) seems to be factually accurate, it does not receive substantial support from such sentences as those represented in Figure 2. Notice that in the figure, the two QNPs reflect two kinds of relations. QNP_1 precedes QNP_2, and at the same time the former c-commands the

latter (A *c-commands* B iff neither dominates the other, and the first branching node dominating A also dominates B). In other words, linear order is confounded with c-command in these structures. To identify the independent contribution of linearity in scope relations, we need to turn to sentences where neither of the mutually commanding QNPs c-commands the other. Some of these cases are represented in Figures 3 and 4. In Figure 3, QNP_1 is a preverbal prepositional object and QNP_2 a postverbal object (either a direct object or a prepositional object). In Figure 4, both QNPs are prepositional objects in preverbal position. The structure in Figure 3 is illustrated by (7-8), while that of Figure 4 is exemplified by (9).

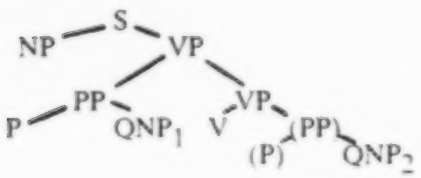

Figure 3

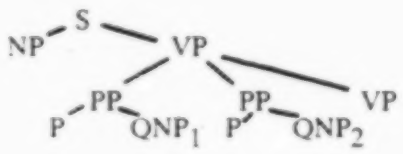

Figure 4

(7) a. Wo changchang [dui liangge nanren] baoyuan meige nuren
I often to two-CL male complain every-CL woman
"I often complain to two men about every woman"
b. There are two x = male such that for all y = woman,
I often complain to x about y.
c. *For all y = woman, there are two x = male such that
I often complain to x about y.

(8) a. Ta [ba yizhong yanse] tu zai meizhang zhuo shang
s/he BA one-CL color paint at every-CL table on
"S/he painted every table with a color"
b. There is a x = color such that for every y = table,
s/he painted y with x.
c. ?For every y = table, there is a x = color such that
s/he painted y with x.

(9) a. Daoyan [gen liangge sheyingshi] [cong meige jiaodu]
director with two-CL cameraman from every-CL angle
paishe changcheng
film Great-Wall
"The director filmed the Great Wall with two cameramen from every angle"
b. There are two x = camerman, such that for every y = angle,
the director filmed the Great Wall with x from y.
c. *For every y = angle, there are two x = camerman, such that
the director filmed the Great Wall with x from y.

In (7-9), on our definition of c-command, neither QNP c-commands the other. The interpretations given in (7b, 8b, 9b) and the ill-formedness of the readings (7c, 9c) show that generally, in accordance with the linearity principle (4b), it

is the QNP that precedes that has wide scope.[7] The marginal status of (8c) suggests that perhaps in some configurations (in this case the *Ba*-construction), scope ambiguity may be possible. We will return to this issue in our discussion of the experimental findings.

One last type of structure that reveals the role of linear order is that given in Figure 5, where both QNPs occur postverbally, one as direct object and the other as prepositional object. (10) gives an example of this structure. On one analysis of the sentence, the verb and the direct object form one constitutent V', which then combines with a PP to form VP.

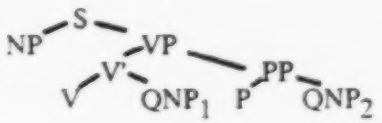

Figure 5

(10) a. Laoshi song le liangben shu gei meige tongxue
teacher give ASP two-CL book to every-CL classmate
"The teacher gave two books to every classmate"
b. There are two x = book such that for all y = classmate
the teacher gave x to y.
c. For all y = classmate, there are two x = book, such that
the teacher gave x to y.

If our constitutent analysis is correct, neither QNP c-commands the other. By (4b), QNP_1 should take wide scope. This is in fact one of the two interpretations of the sentence. However, unlike sentences such as (3, 7, 9), which are unambiguous, more than one scope reading is possible with sentences like (10), as first observed by Aoun and Li (1987). Suffice it to say at this point that the linearity principle allows us to predict some, if not all, of the scope interpretations of a clause and that the principle does not make false predictions. Further observations will be made about scope ambiguity in later sections.

3. *Children's Understanding of Quantifier Scope*

An earlier study (Lee 1986) investigated how Mandarin-speaking children aged between three and eight comprehended the relative scope of QNPs in subject and object positions, i.e. sentences represented by Figure 2. A major finding of the study was that Chinese children probably interpreted QNPs as inherently referential; clear evidence for the variable-binding property of QNPs was not observed among the children until after five. In other words, given a sentence such as (11), three- to five-year-olds interpreted *yige dangao* 'a cake' as referring to a specific entity.

(11) a. Meige xiaohai dou zai chi yige dangao .
every-CL child all ASP eat one-CL cake
"Every child is eating a cake"

b. For all x = child, there is a y = cake such that
x is eating a cake.

The reading according to which different children are eating different cakes was clearly evidenced only in the older age groups. The study, however, failed to establish the scope interpretation principles assumed by children once the variable-binding property of QNPs is understood. The subject QNP both precedes and c-commands the object QNP (cf. Figure 2), and to the extent that children interpreted QNP_1 as having wide scope, it is unclear whether they were following linear precedence or c-command.

3.1 *Test Material*

To overcome the inadequacies of the earlier study, the test sentences of the present experiment include QNPs that do not show any c-command relationship, i.e. those illustrated in Figures 3 and 5. Three sentence types were used, as given in (12-14).[8] The first sentence type shows QNP_1 in a preverbal locative phrase (a prepositional phrase headed by *zai* 'at') and QNP_2 as a postverbal object. As observed earlier (cf. sentence (7) and Figure 3), this type of sentence is unambiguous, with QNP_1 having scope over QNP_2.

(12) Sentence Type I (*zai*-sentences)

a. X zai *yige dengzi* shang fang *meigen shengzi* (EA)
at one-CL stool on put every-CL string
"X puts every string on a stool"

b. X zai *meige dengzi* shang dou fang *yigen shengzi* (AE)
at every-CL stool on all put one-CL string
"X puts a string on every stool"

c. X zai *yige xiaohai* shenshang gai *meitiao maojin* (EA)
at one-CL child body-on lay every-CL towel
"X lays every towel on a child"

d. X zai *meige xiaohai* shenshang dou gai *yitiao maojin* (AE)
at every-CL child body-on all lay one-CL towel
"X lays a towel on every child"

The second type of sentence involves QNP_1 as direct object and QNP_2 as a postverbal object of a locative phrase (a prepositional phrase headed by *zai* 'at'). As discussed earlier (cf. sentence (10) and Figure 5), two scope interpretations are possible for these sentences, with the linearity principle predicting only one of the two readings.

(13) Sentence Type II (V-sentences)

a. X fang *yigen shengzi* zai *meige dengzishang* (EA)
put one-CL string at every-CL stool-on
"X puts a string on every stool"

b. X fang *meigen shengzi* zai *yige dengzishang* (AE)
put every-CL string at one-CL stool-on
"X puts every string on a stool"

c. X gai *yitiao maojin* zai *meige xiaohai* shenshang (EA)
lay one-CL towel at every-CL child body-on

"X lays a towel on every child"

d. X gai *meitiao maojin* zai *yige xiaohai* shenshang (AE)
lay every-CL towel at one-CL child body-on
"X lays every towel on a child"

The third sentence type used in the experiments is the *Ba*-construction illustrated earlier by sentence (8) and Figure 3. In this sentence type, QNP_1 serves as the object of the preverbal *Ba*-prepositional phrase, while QNP_2 functions as the object of a postverbal locative phrase (a prepositional phrase headed by *zai* 'at'). For this sentence type, the dominant reading is recognized to be that with QNP_1 having wide scope, and the interpretation with QNP_2 having wide scope is considered marginal.[9]

(14) Sentence Type III (*Ba*-sentences)

a. X Ba *yigen shengzi* fang zai *meige dengzi* shang (EA)
BAone-CL string put at every-CL stool on
"X puts a string on every stool"

b. X Ba *meigen shengzi* dou fang zai *yige dengzi* shang (AE)
BAevery-CL string all put at one-CL stool on
"X puts every string on a stool"

c. X Ba *yitiao maojin* gai zai *meige xiaohai* shenshang (EA)
BAone-CL towel lay at every-CL child body-on
"X lays a towel on every child"

d. X Ba *meitiao maojin* gai zai *yige xiaohai* shenshang (AE)
BAevery-CL towel lay at one-CL child body-on
"X lays every towel on a child"

In the test sentences (12-14), X stands for the name of the child subject. There are two prop settings corresponding to each sentence type, one involving the placement of strings on stools, and the other requiring the positioning of towels over the bodies of dolls. The props are illustrated in Figures 6 and 7. The (a,b) sentences in (12-14) refer to the prop setup in Figure 6, while the (c,d) sentences correspond to the props in Figure 7.

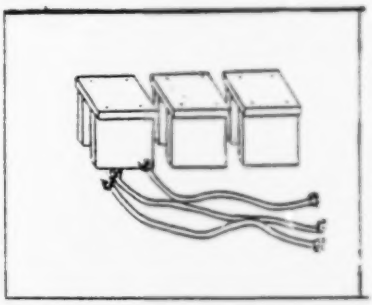

Figure 6

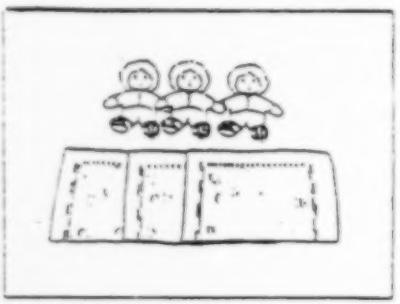

Figure 7

For each sentence type and prop setting, two quantifier orders were used, an EA order with an existential QNP preceding a universal QNP, as well as an AE order with a universal QNP

preceding an existential QNP. The (a) and (c) sentences in (12-14) show EA order, whereas the (b) and (d) sentences display AE order. A total of 3 (sentence type) x 2 (prop setting) x 2 (quantifier order) = 12 sentences were employed.[10]

3.2 *Procedure*

117 Mandarin-speaking children aged between three and eight were drawn from two kindergartens and two primary schools in Beijing. The subjects included 16 three-year-olds, 21 four-year-olds, 21 five-year-olds, 19 six-year-olds, 20 seven-year-olds, and 20 eight-year-olds. In addition, a group of adults were tested as control.

The children were interviewed individually, each for about 20 minutes. They were shown the props by the writer and another researcher, who is a native speaker of Mandarin, and the test sentences were read to them. The subjects were then asked to act out the meaning of the sentences. Only act-out tasks were used, because in Lee (1986), it was found that children were much more consistent in act-out tasks than in picture identification tasks when responding to sentences containing more than one QNP. In the experiment, the prop settings and the test sentences for each prop setting were randomized and were used together with some other picture-identification items not directly related to the relative scope of QNPs.

The experiment has a four-part structure summarized as follows:

Part I: Training tasks
  a. two training sentences for toy manipulation
  b. two training sentences for picture identification
Part II: Picture identification tasks (two sentences)
  Act-out Tasks
  Prop Setting A (cf. Figure 6): three sentences
  Prop Setting B (cf. Figure 7): three sentences
Part III: Picture identification tasks (two sentences)
  Act-out Tasks
  Prop Setting B (cf. Figure 7): three sentences
  Prop Setting A (cf. Figure 6): three sentences
Part IV: Picture identification tasks (two sentences)
  Act-out Tasks
  Prop Setting B (cf. Figure 7): three sentences
  Prop Setting A (cf. Figure 6): three sentences

The experimental procedure for adults differed slightly from that for children. Adult subjects were interviewed in groups of five to six rather than individually. Instead of using the subject's name in the position of X in the test sentences, the morpheme *qing* 'please' was used as X. Adults were shown the props and were asked to represent their interpretation schematically with pencil and paper (e.g. using lines to represent strings and rectangular boxes to symbolize stools).

4. *Results*

4.1 *Predictions based on the Linearity Principle*

If the linearity principle (4b) is correct, then one should predict that the wide scope of QNP_1 is available for all the test sentences. For unambiguous sentences such as the *zai*-sentences in (12) (Type II, cf. Figure 3), one should expect QNP_1 to predominantly receive wide scope interpretation in the adult and older age groups. For sentences where ambiguity exists, perhaps marginally, such as the V- sentences of (13) (Type II, cf. Figure 5) and the *Ba*-sentences of (14) (Type III), the wide scope reading of QNP_1 should at least show up as a major pattern in the adults and older subjects.

The children's performance, however, may show a task bias which will affect how they respond to sentences of the AE and EA orders. In the experiment, the subjects were shown three objects (stools or dolls) which refer to the location or goal of three other objects (strings or towels), and were asked to act according to their understanding of the test sentences. Earlier studies (cf. Donaldson and McGarrigle 1974) suggest that in such prop settings, children are likely to put objects in one-one correspondence without really attending to the linguistic clues in the sentence.[11] This potential danger may be especially evident in the youngest groups, who may not have acquired stable knowledge of the relevant linguistic principles. In other words, given a sentence of AE order, with a universal quantifier as QNP_1, the children may place strings and stools, or towels and dolls, in one-one correpondence, giving the semblance of a wide scope reading of QNP_1. This response may be a reflection of task bias rather than an understanding of the linearity principle. If a task bias indeed exists, then one would expect the younger children to pair the two sets of props irrespective of quantifier order, i.e. children's responses to the AE sentences may superficially resemble a wide scope of QNP_1 interpretation, and their responses to the EA sentences may seem to suggest a wide scope of QNP_2 reading. The predictions of our analysis are given in Table 1.

Table 1. Predicted Results based on Linearity and Task Bias

Sentence Type	Linear Order	Task Bias	Testing Case for Linearity
zai EA	wide scope of E	wide scope of A	yes
zai AE	wide scope of A	wide scope of A	no
V EA	wide scope of E	wide scope of A	yes
V AE	wide scope of A	wide scope of A	no
Ba EA	wide scope of E	wide scope of A	yes
Ba AE	wide scope of A	wide scope of A	no

According to the linearity principle, the first QNP should take wide scope irrespective of sentence type and quantifier type, as shown in column two of the table. If subjects act only under the influence of the task bias, they will respond as though they were opting for the wide scope of the universal quantifier, irrespective of quantifier order, as shown in column three. If the responses predicted by linearity happen to be also predicted by the task bias, as is the case with all the AE sentences, the result will not tell us the precise role of linear order in the children's interpretation. If, however, the responses based on linearity are exactly the opposite of that due to task bias, as in all the EA sentences, then evidence for the wide scope interpretation of the existential quantifier can be construed as a very strong indication that children are following linear precedence in interpreting scope. The sentences that inform us of the role of linearity are marked 'yes' in column four. As our results will reveal, the task bias indeed influenced the younger subjects.

4.2 *Experimental Results*

The data reported here is concerned with the scope-differentiated interpretations of the subjects. Responses that cannot be classified as corresponding to the wide scope of one of the QNPs are excluded from our analysis.[12] Corresponding to each sentence type and quantifier order, three categories of responses are distinguished. One type of response shows subjects consistently assigning wide scope to QNP_1 on the two test sentences (cf.the two prop arrangements). Another type of response shows subjects who consistently take QNP_2 as the wide scope quantifier on the two test sentences. In the third type of response, subjects fluctuate between the wide scope of QNP_1 on one test sentence and the wide scope of QNP_2 on the other. That is, the third category consists of inconsistent responses.

4.2.1 *Results on zai-sentences* (Type I)

Figure 8 gives the results on the *zai*-sentences with EA order. The lines connected by squares represent the percentage of an age group that consistently chose the wide scope of QNP_1 (in this case the existential quantifier). The graph marked by crosses represents the percentage of an age group that consistently violated the linearity principle by choosing the wide scope reading of QNP_2 (in this case the universal quantifier). The lines joined by diamonds show the proportion of an age group that varied between the two scope interpretations. Here, a wide scope interpretation of E is one where all the strings/towels are placed on a single stool/doll. A wide scope interpretation of the universal quantifier is one where each of the strings/towels is placed on a different stool/doll.

With respect to the adult subjects, it is clear that the majority of them (70%) consistently assigned wide scope to E in accordance with the linearity principle. A small percentage (5%) consistently interpreted the universal quantifier as wide scope, violating linearity.

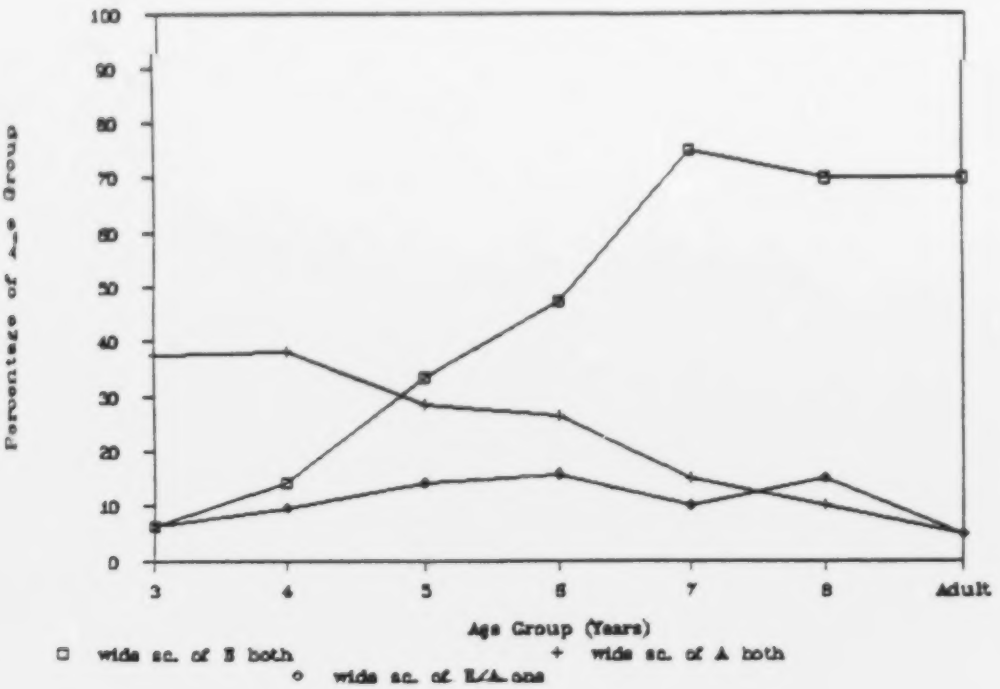

Figure 8. Children's Interpretation of *zai*-sentences
Existential Quantifier (E) precedes Universal Quantifier (A)
Type I: NP [zai QNP_1] V QNP_2
E A

Another five percent gave inconsistent responses.[13] The reason why the adults did not show a higher level of uniformity as one would expect may be related to a lexical idiosyncracy of *mei* 'every': quantification of postverbal theme/patient objects by *mei* often results in unnatural sentences (see Xu and Lee 1989 for discussion).

The responses of the children subjects display a clear pattern. The percentage of three- and four-year-olds who assigned wide scope to E was very low (6% and 14% respectively). However, this percentage increased steadily with age to a peak of 75% at age seven. The initially low level of correct responses may have been due to the task bias discussed above, which gradually became overridden by the linguistic principles of scope interpretation. Turning to the subjects who consistently violated linearity, 38% of the three- and four-year-olds assigned wide scope to the universal quantifier. The figure declined steadily after five to a low of 10% at age eight. Later discussion will show that the apparent violation of linearity in the younger age groups was due to the task bias, which exerted a noticeable influence when the linearity principle had not been firmly established. It is worthy of note that the children were generally consistent in their

performance: the inconsistent responses never accounted for *more than 16% of an age group.*

The results on the *zai*-sentences with AE order are presented in Figure 9. As in Figure 8, the lines marked with squares indicate the percentage of an age group that opted for the wide scope of QNP_1 (in this case A) reading on both test sentences. The graph with crosses represents the percentage of an age group that chose the wide scope of QNP_2 (in this case E) on both sentences. A wide scope of A response is one where the strings/towels are each placed on a different stool/doll. A wide scope of E response is one where a single string/towel is lain across all three stools/dolls.

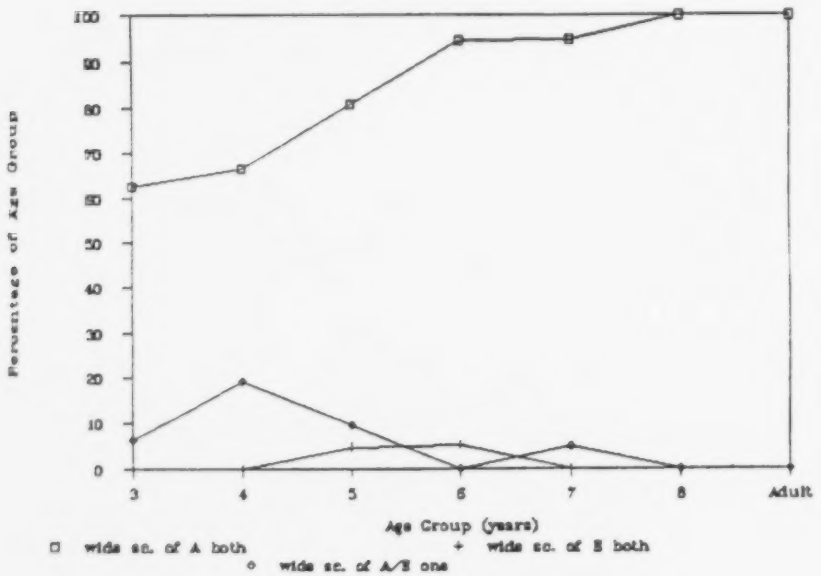

Figure 9. Children's Interpretation of *zai*-sentences
Universal Quantifier (A) precedes Existential Quantifier (E)
Type I: NP [zai QNP_1] V QNP_2
A E

If the children were acting exclusively according to linguistic principles, the pattern of responses in the two figures should be highly similar, since the only difference between the test sentences lies in quantifier order. That is to say, one would expect the wide scope of QNP_1 reading to show similar paths of development in the two figures. However, the patterns revealed in the figures are strikingly different. First, with respect to the adult subjects, all of them consistently assigned wide scope to the universal quantifier in accordance with linearity. The unanimous adult response may be due to the fact that in the *zai*-sentences with AE order, the universal quantifier *mei* 'every' no longer quantifies a postverbal patient/theme object, but rather quantifies a locative phrase. The test sentences are therefore perfectly natural.

In contrast to the data on *zai*-sentences with EA order, the wide scope of QNP_1 response is evidenced fairly early in the *zai*-sentences with AE order. 63% of the three-year-olds and 67% of the four-year-olds gave this response. The figure climbed to 81% by five and 95% by age six. The surprisingly early onset of the wide scope of QNP_1 reading consistent with linearity and the relatively higher percentage of this response across all age groups may be attributed to the task bias.

Also different from the patterns of the *zai*-sentences with EA order, where some of the children (between 10% and 38%) across all ages chose the wide scope of QNP_2 reading in apparent violation of linearity (see Figure 8), extremely few children chose the wide scope of QNP_2 reading in the *zai*-sentences with AE order. None of the three-, four-, seven- and eight-year-olds showed this response, and only 5% of the five- and six-year-olds offered this interpretation. This suggests that, when a violation of the linearity principle was not favored by the task bias, virtually no consistent violations of linearity could be observed.

Figure 9 also indicates that as in Figure 8, the percentage of children showing inconsistent responses on *zai*-sentences with AE order was small. Except for the four-year-olds, less than 10% of the age groups showed inconsistent interpretations.

In order to ascertain whether the younger children were acting according to linguistic principles or were mainly influenced by experimental setting, it was decided to compare the children's responses on the EA sentences with their responses on the corresponding AE sentences which involve the same props. The comparison should inform us as to whether children were sensitive to the distinction between EA and AE ordering. Tables 2 and 3 below provide information about four categories of responses for subjects who showed scope-differentiated responses. In both tables, column three gives the number of subjects who consistently followed the linearity principle, assigning QNP_1 wide scope regardless of whether it is an existential or universal quantifier. Column four shows the number of subjects who consistently violated the linearity principle by assigning QNP_2 wide scope irrespective of quantifier type. The last two columns show the numbers of subjects who assigned wide scope to particular quantifiers irrespective of quantifier position. Column five gives the figures for those who indiscriminately assigned wide scope to the universal quantifier, while column six gives the figures for those who indiscriminately interpreted the existential quantifier as having wide scope.

As can be seen from the figures in the third column of the two tables, less than 10 subjects (i.e less than 50%) among the three- to five-year-olds consistently used the linearity principle when presented with a particular set of props and different quantifier orders. The relevant figure, however, climbed steadily to between 14 and 18 subjects among the seven- and eight-year-olds. Note that the number of subjects who

consistently violated the linearity principle (cf. column Four) never exceeded 3 among the three- and four-year-olds, and was nil in the other age groups. This argues convincingly for the growth of linearity as a scope principle for the children subjects.

Table 2. Children's interpretation of *zai*-sentences
EA order vs AE order
(Prop Setting A: strings and stools)

Age (yr)	No.of subjects	wide sc. of E on EA wide sc. of A on AE	wide sc. of A on EA wide sc. of E on AE	wide sc. of A on EA wide sc. of A on AE	wide sc. of E on EA wide sc. of E on AE
3	10	2	0	8	0
4	17	7	0	10	0
5	18	9	1	8	0
6	18	12	0	6	0
7	20	16	0	4	0
8	19	14	0	5	0
Adult	18	17	0	1	0

Table 3. Children's interpretation of *zai*-sentences
EA order vs AE order
(Prop Setting B: towels and dolls)

Age (yr)	No.of subjects	wide sc. of E on EA wide sc. of A on AE	wide sc. of A on EA wide sc. of E on AE	wide sc. of A on EA wide sc. of A on AE	wide sc. of E on EA wide sc. of E on AE
3	9	0	0	8	1
4	14	2	3	9	0
5	17	8	1	7	1
6	17	10	0	7	0
7	19	15	0	4	1
8	20	18	0	2	0
Adult	18	16	0	2	0

At the same time, between 7 and 10 (cf. column Five) of the three- to five-year-olds assigned wide scope to the universal quantifier irrespective of quantifier order. The number of subjects exhibiting this tendency dropped to 5 or less in the seven- and eight-year-olds. Note, however, that the figures in column Six show that virtually no subject indiscriminately assigned wide scope to the existential quantifier irrespective of quantifier position. The data thus strongly supports the existence of a task bias which favors a one-one correspondence of props, which must be taken into consideration in our analysis.

4.2.2 *Results on V-sentences* (Type II)

The data on the subjects' interpretation of the relative scope of two postverbal QNPs are given in Figures 10 and 11.

Figure 10 reports on the test sentences with EA order. First of all, examining the adult data, one notices that the percentage of adults who consistently assigned wide scope to QNP_1 (=E) was only 55%, while the percentage of adults assigning wide scope to QNP_2 (=A) was 25%, with another 15% varying between the two readings. This suggests that adults found these sentences scope-ambiguous.

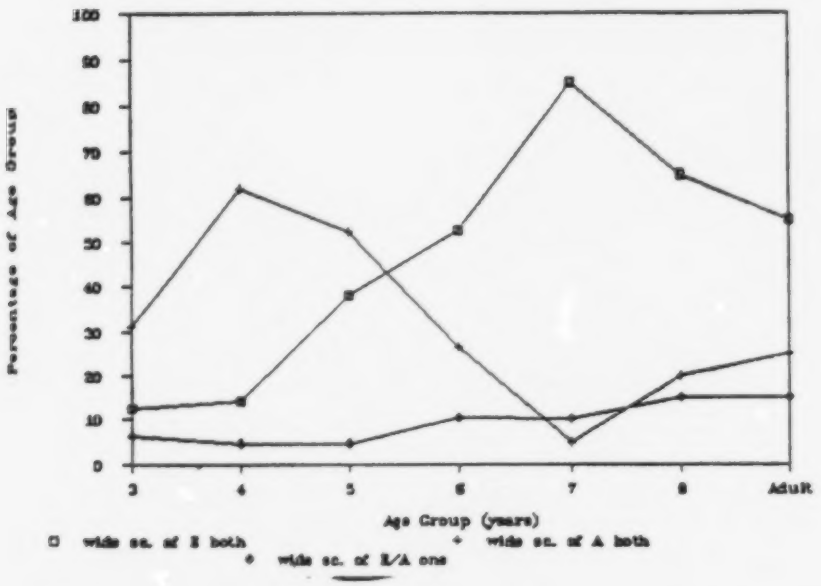

Figure 10. Children's interpretation of V-sentences.
Existential Quantifier (E) precedes Universal Quantifier (A).
Type II: NP V QNP_1 [P QNP_2]
E A

Turning to the children's performance, we see that as with the *zai*-sentences, the percentage of three- and four-year-olds who took QNP_1 as the wide scope quantifier was very low (13% and 14% respectively). The figure for this response climbed to 38% at age five, and reached a peak of 85% at seven. There is good evidence to believe that the initially low figure had to do with the task bias. As the children matured, the linearity principle became gradually established, thereby strengthening the wide scope of QNP_1 reading. It is interesting to observe that unlike the results in the *zai*-EA sentences, the linearity-based reading for the V-sentences with EA order dropped after seven years of age to 65% at eight. This suggests that linearity is counterbalanced by some other scope principle in the older age groups.

As for the percentage of subjects consistently choosing QNP_2 as having wide scope, the figure stood at 31% at age three, increased to 62% among the four-year-olds, and then steadily declined to a low of 5% at age seven. Thereafter, the figure rebounded to 20% in the eight-year-old group. Again,

the general decline in this type of response (except for a slight increase in the four-year-olds) alongside the growth of the linearity principle parallels what we observed in the *zai*-EA sentences. Evidently, the task bias exerted its influence mainly in the younger age groups. The slight rise in the wide scope of QNP_2 (=A) reading among the eight-year-olds, which happened concurrently with the drop in the linearity-based reading, is another indication of the ambiguity of this type of sentence. With regard to the third type of response, a very low level of inconsistency (between 5% and 15%) can be observed, corroborating the finding on *zai*-EA sentences.

The adult data for the V-sentences with AE order, given in Figure 11, show considerable similarity to the corresponding data in the V-sentences with EA order (refer to Figure 10 above). 30% of the subjects consistently selected the wide scope of QNP_1 interpretation in accordance with linear precedence. 25% of them consistently assigned wide scope to QNP_2 (=E), and 40% of them vacillated between the two readings. This confirms the ambiguity status of the sentences. It should also be observed that unlike the V-sentences with EA order, the V-sentences with AE order involve a lexical idiosyncracy of *mei* 'every' discussed earlier, since it quantifies a postverbal patient/theme object in these sentences. As a result, the V-sentences with AE order sound unnatural to native speakers of Mandarin.[14]

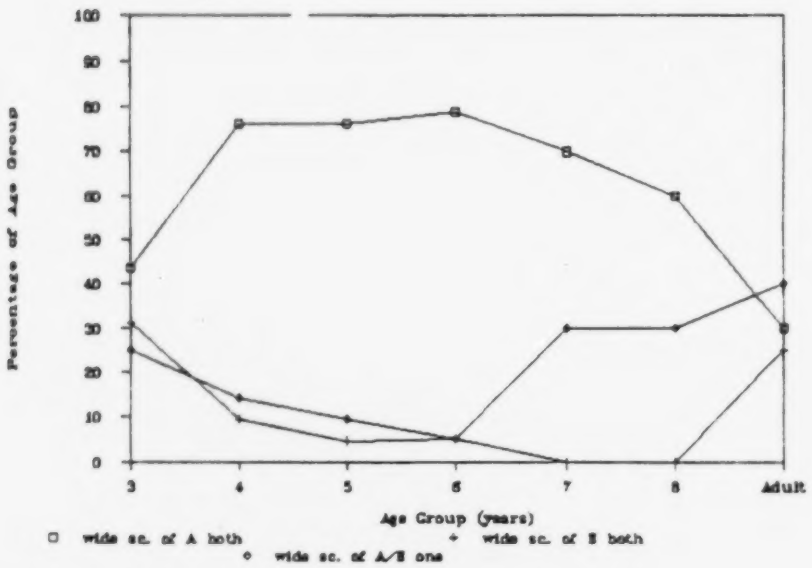

Figure 11. Children's interpretation of V-sentences.
Universal Quantifier (A) precedes Existential Quantifier (E).
Type II: NP V QNP_1[P QNP_2]
A E

Just as the children's data on EA and AE orders for the *zai*-sentences show divergent patterns, so the developmental

findings on V-sentences with AE order, given in Figure 11, do not replicate those with EA order (cf. Figure 10). First of all, a relatively higher percentage of the younger age groups chose the wide scope interpretation of QNP_1 on the AE order than on the EA order. 44% of the three-year-olds selected this reading. The value increased to 76% at age five and stayed at that level until six years of age, then dropping to 60% among the eight-year-olds. Parallel to a similar decline after seven in Figure 10, a decline in the wide scope of QNP_1 reading after six was observed, presumably due to the emergence of ambiguity of these sentences for the children. Secondly, a small number (30%) of children opted for the wide scope of QNP_2 (=E) at the three-year-old level, but the value dropped sharply to 5% in the five- and six-year-olds, and 0% after six. This suggests that whatever the principle is that contributes to the wide scope reading of QNP_2, it does not seem to be sufficiently strongly established in the older age groups to allow them to go against the task bias, which favors the wide scope of QNP_1 reading in this case. Thirdly, with respect to the inconsistent responses, a fairly high level of the three-, four-, seven- and eight-year-olds (between 14% and 30%) assigned wide scope to QNP_1 on one sentence and to QNP_2 on another. This relative high level of inconsistency, especially among the older age groups, may be an indirect reflection of the scope ambiguity of the sentences. It may also be due to the violation of the lexical properties of *mei* 'every', which prohibits quantification of postverbal theme/patient objects.

To determine whether subjects were sensitive to quantifier order for the V-sentences, comparisons of subjects' responses on AE and EA sentences were made for each prop setting. These are shown in Tables 4 and 5 below.

Table 4. Children's interpretation of V- sentences
EA order vs AE order
(Prop Setting A: strings and stools)

Age (yr)	No.of subjects	wide sc. of E on EA wide sc. of A on AE	wide sc. of A on EA wide sc. of E on AE	wide sc. of A on EA wide sc. of A on AE	wide sc. of E on EA wide sc. of E on AE
3	8	1	0	7	0
4	19	4	0	15	0
5	20	7	0	11	2
6	18	8	0	7	3
7	20	18	1	0	1
8	20	14	1	3	2
Adult	18	4	3	4	7

Column three of the two tables show that only 1 three-year-old, 4 three-year-olds and 7 five-year-olds assigned wide scope to QNP_1 irrespective of quantifier type. This figure increased to a peak of 14-18 among the seven-year-olds, followed by a slight drop after seven. The pattern is similar to that we found for the *zai*-sentences, showing children did not successfully apply linear precedence as a consistent

Table 5. Children's interpretation of V-sentences
EA order vs AE order
(Prop Setting B: towels and dolls)

Age (yr)	No.of subjects	wide sc. of E on EA wide sc. of A on AE	wide sc. of A on EA wide sc. of E on AE	wide sc. of A on EA wide sc. of A on AE	wide sc. of E on EA wide sc. of E on AE
3	5	1	0	4	0
4	15	4	0	11	0
5	19	7	1	10	1
6	16	9	0	6	1
7	20	14	1	2	3
8	18	10	1	5	2
Adult	20	8	3	4	5

principle until after six. Column five of the two tables indicate that between 4 and 15 of the three-, four-, and five-year-olds assigned wide scope to the universal quantifier irrespective of quantifier order, pointing to the influence of the prop arrangement. The number of subjects showing this type of response dropped after six years of age to 7 or less, demonstrating clearly that the task bias was overridden by linguistic principles beyond a certain point of development. A glance at column four shows that virtually no subject consistently violated the linearity principle across all age groups.

4.2.3 *Results on Ba-sentences* (Type III)

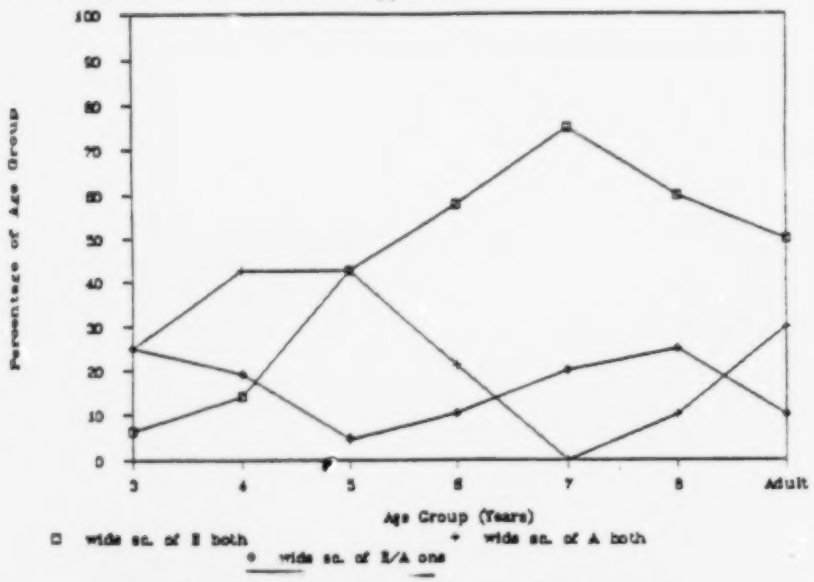

Figure 12. Children's interpretation of *Ba*-sentences.
Existential Quantifier (E) precedes Universal Quantifier (A).
Type III: NP [*BA* QNP_1] V [P QNP_2]
E A

The results on the *Ba*-sentences with EA order, given in Figure 12, resemble those on EA order for the other two sentence types. The adult responses suggest that the construction may be scope ambiguous, since 50% of them consistently treated QNP_1 (=E) as having wide scope, while 30% of them consistently assigned QNP_2 (=A) wide scope, and 10% varied between the two readings.

The children's responses on *Ba*-sentences with EA order show a very low percentage of three-year-olds (6%) assigning wide scope to QNP_1. The figure grew steadily to 44% by age five and peaked at seven at 75%. The slight drop (to 60%) among the eight-year-olds may be an indication of the scope ambiguity of the *Ba*-construction. The proportion of subjects who consistently violated the linearity principle, presumably under the influence of the prop setting, was 25% at age three, increasing to a plateau of 43% among the four- and five-year-olds. This figure then dropped to zero at age seven, followed by a slight rise among the eight-year-olds. The increase in wide scope of QNP_2 in the eight-year-olds, which was also observed in the V-sentences with EA order (cf. Figure 10), suggests the realization of the scope ambiguity of *Ba*-sentences. Compared to the level of inconsistent readings in Figure 8 and Figure 10, the percentage of subjects that vacillated between the two readings was relatively high across the age groups: with the exception of the five-year-olds, between 10% and 25% of subjects chose QNP_1 as the wide scope quantifier on one sentence and QNP_2 on the other.

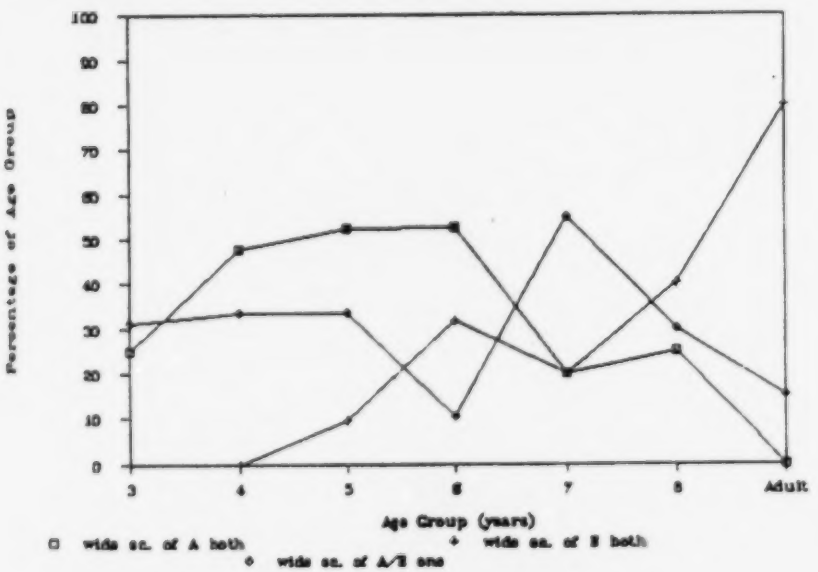

Figure 13. Children's interpretation of *Ba*-sentences.
Universal Quantifier (=A) precedes Existential Quantifier (=E).
Type III: NP[*Ba* QNP_1 (A)] V [P QNP_2 (E)]

The results on the *Ba*-sentences with AE order, given in Figure 13, differ not only from the data on *Ba*-sentences with EA order, but also from the *zai*-sentences and V-sentences with AE order (cf. Figures 9 and 11). The adult data below indicate that 80% of them interpreted QNP_2 (=E) as having wide scope, none assigned wide scope to QNP_1 (=A), and 15% varied between the two scope possibilities.

If we trace the development of the wide scope reading of QNP_1, 25% of the three-year-olds selected this interpretation. The figure rose to around 50% at ages five and six, then declined to 20%-25% among the seven- and eight-year-olds. The overall developmental pattern for these sentences is similar to that for the wide scope of QNP_1 reading in the V-sentences with AE order (cf. Figure 11), except that the percentages are generally lower in the *Ba*-sentences. What distinguishes the *Ba*-sentences from the V-sentences lies in the development of the wide scope interpretation of QNP_2 with age in the *Ba*-sentences with AE order. In contrast to the other sentence types, none of the three- and four-year-olds opted for the wide scope of QNP_2 here, apparently due to the task bias. Around 10% of the five-year-olds showed this response, which increased to 32% by six years of age, dropped slightly and rebounded to 40% at age eight. This developmental path differed considerably from that of the *zai*- and V-sentences. Instead of either a low level or a general decline of wide scope of QNP_2 responses, this type of response in fact grew continually in the *Ba*-sentences with AE order, suggesting an increase in violation of the linearity principle with age. A third difference between the *Ba*-sentences and the other two sentence types lies in the unusually high level of inconsistencies in the children's responses. With the exception of the six-year-olds, between 30 and 35% of the subjects assigned wide scope to different QNPs on the two test sentences.

To determine the extent to which children relied on linguistic principles in their responses, their performance on the EA and AE sentences in the same prop setting was examined. These findings are listed in Tables 6 and 7.

Table 6. Children's interpretation of *Ba*-sentences
EA order vs AE order
(Prop Setting A: strings and stools)

Age (yr)	No.of subjects	wide sc. of E on EA wide sc. of A on AE	wide sc. of A on EA wide sc. of E on AE	wide sc. of A on EA wide sc. of A on AE	wide sc. of E on EA wide sc. of E on AE
3	8	2	1	5	0
4	16	3	5	8	0
5	19	7	2	8	2
6	17	6	1	5	5
7	19	7	0	2	10
8	18	7	2	2	7
Adult	18	1	9	0	8

Table 7. Children's interpretation of *Ba*-sentences
EA order vs AE order
(Prop Setting B: towels and dolls)

Age (yr)	No.of subjects	wide sc. of E on EA / wide sc. of A on AE	wide sc. of A on EA / wide sc. of E on AE	wide sc. of A on EA / wide sc. of A on AE	wide sc. of E on EA / wide sc. of E on AE
3	11	2	0	6	3
4	17	6	0	10	1
5	20	5	1	9	5
6	18	7	0	4	7
7	19	8	1	1	9
8	20	5	4	2	9
Adult	19	0	5	2	12

Column three of the tables shows that relatively few subjects consistently followed the linearity principle: only 2 two-year-olds and less than 8 subjects of the other age groups consistently assigned wide scope to QNP_1. In contrast to what we observed in the *zai*-sentences and the V-sentences, no noticeable growth in the linearity principle can be observed in the *Ba*-sentences.

Two other tendencies in the data are worth noting. One is that the three- to five-year-olds had a tendency to assign wide scope to the universal quantifier regardless of quantifier position (cf. column five of the tables). Another tendency, which has hitherto been absent from the data on the other sentence types, is that the six-, seven, and eight-year-olds had a tendency to assign wide scope to the existential quantifier, regardless of quantifier position (cf. column six of the two tables). Why is there such a tendency unique to the *Ba*-construction? The answer may lie in one of the salient properties of the construction (cf. Note 9), i.e. the *Ba*-object is generally understood to be definite or specific (cf. Ding 1962, Li and Thompson 1981). Assuming that this property of the *Ba*-construction is acquired at some point, subjects who have grasped this property will give what might seem to be a wide scope of E on EA sentences, since the *Ba* object for these sentences is E. Likewise, on AE sentences, they will regard the universal quantifier functioning as the *Ba*-object as referring to a group of entities. This set will not be distributed, and as a result the response is in fact a group reading associating a set of three objects with another object. Such a reading superficially is no different from a wide scope of QNP_2 (=E) reading.

5. *Discussion*

Our data demonstrates that linear order is a strong scope interpretation principle for Chinese, and that it is firmly acquired at around age seven. This can be seen from the similarities shared by the developmental patterns of the EA

sentences across the three sentence types. Comparing the graphs of Figures 8, 10, and 12, one observes that in all three figures, the percentage of an age group that selected the consistent wide scope reading of QNP_1 (=E) began at around 10% at age three, climbed to approximately 40% at five, and peaked at 70-80% by seven years of age. Concurrent with the gradual strengthening of linearity, one also observes a decline in the consistent wide scope reading of QNP_2 between five and seven years of age. The subjects' acquisition of the linearity principle is also reflected in their differential responses to sentences with EA and AE orders. In all three sentence types (cf. Tables 2 through 7), sensitivity to quantifier order was recorded after five, and the adoption of the linear precedence principle was evidenced with respect to the *zai*- and V-sentences.

The differences between the sentence types point to the presence of scope ambiguity in the V-sentences and possibly the *Ba*-sentences as well. With respect to the EA order, one difference between the V- and *Ba*-sentences on the one hand (cf. Figures 10 and 12) and the *zai*-sentences on the other (cf. Figure 8) is that the wide scope interpretation of QNP_1 showed a marked decline in the former sentence types after age seven, but not in the latter. Parallel to this difference is the slight rise in the wide scope reading of QNP_2 after seven, in the V- and *Ba*-sentences but not in the *zai*-sentences. The presence of scope ambiguity can also be seen from the divergences among the AE sentences. While the consistent wide scope reading of QNP_1 (=A) showed a steady increase in the *zai*-sentences (cf. Figure 9), that of the V- and *Ba*-sentences (cf. Figures 11 and 13) indicated a steady decline after four. The decline of the wide scope of QNP_1 reading in a prop setting that favored such a reading is another indication of the availability of scope ambiguity.

Why is there ambiguity in the V- and *Ba*-sentences and not in the *zai*-sentences? It has been proposed by (Xu and Lee 1989) that scope ambiguity in Chinese is restricted to the verb phrase, and stems from the joint effects of the linearity principle and a thematic hierarchy given below:

Thematic Hierarchy
(Group A): Agent, Location, Source, Goal
(Group B): Theme, Patient, Factitive (Narrow Scope Thematic Roles)

The thematic roles in Group A are higher on the hierarchy than those in Group B as far as scope is concerned. In general, if a QNP bears a thematic role which is higher on the thematic hierarchy than another QNP within the same VP, then the former may have scope over the latter. In the *zai*-sentences, QNP_1 precedes QNP_2 and should therefore have scope over the latter by the linearity principle. At the same time, QNP_1 bears a location thematic role, which takes priority over the theme/patient role borne by QNP_2 according to the thematic hierarchy. Therefore by both principles, QNP_1 should take wide scope, and the sentence is unambiguous. In the V-sentences, QNP_1 should likewise have wide scope by the linearity

principle. However, QNP_2 bears the location role, which is higher on the thematic hierarchy than the theme/patient role carried by QNP_1. The conflicting demands of the two scope interpretation principles give rise to ambiguity. This analysis of the V-sentences should extend to the *Ba*-sentences, though there may be construction-specific effects unique to the *Ba*-sentences in view of the sharp rise of the wide scope of QNP_2 (=E) reading in the AE sentences (cf. Figure 13).

6. *Conclusions*

Assuming the relevance of the linear precedence to the scope interpretation of adult Mandarin, we set out to investigate the development of this principle in Mandarin-speaking children, with a view to providing a basis for further study of parametric variation. Three kinds of sentences were examined all of which contained mutually commanding QNPs that do not c-command each other. The three sentence types also differed with respect to the possibility of scope ambiguity.

The findings reveal that quantifier order is distinguished by Chinese children by six and that the linearity principle for scope interpretation is firmly established by seven. There is also evidence to suggest that if scope ambiguity is entirely due to the operation of the thematic hierarchy, the latter scope interpretation principle is acquired late, probably after seven. The data on *Ba*-sentences also indicate that construction-specific effects related to definiteness may affect subjects' judgment of quantifier scope.

Notes

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[1]The relative scope property is of course not restricted to QNPs. Other quantificational elements such as negators, adverbs and modals also display relative scope. This study focuses on the relative scope of QNPs.

[2]An example of a well-formedness condition on the binding of variables is that operators must bind variables. Thus a representation with operators not associated with any variables will be ill-formed and uninterpretable, e.g. "There is a x=person such that John saw Mary".

[3]Quine (1973) suggests that variable-binding may be learned

inductively from wh-questions. For example, children may observe the interchangeability of *who* and *the teacher* in exchanges like the following:

A: John is *the teacher*
B: *Who* is John? (For which x = person, x is John)

Since wh-questions involve the binding of variables by wh-operators, substitutional contexts such as the one above may be a source of the child's knowledge of variables. Our objection to Quine's analysis is twofold. On theoretical grounds, it seems that even if children manage to learn that interrogative pronouns can be interpreted as bound variables, how do they generalize this knowledge to QNPs? In addition, how are children able to learn well-formedness conditions such as that illustrated in Note 2? If well-formedness constraints are biological givens, then the notion of variable binding must also be innately given, since the constraints are stated in terms of operators and variables. On empirical grounds, too, as our data will reveal, it is doubtful whether the learning of wh-bound variables can be extended in a straightforward way to the variable binding of QNPs. The literature shows clearly that canonical *who- what- where*-questions are understood by four at least in some verbal contexts (cf. e.g. Brown 1968, Cairns and Hsu 1978, Tyack and Ingram 1977). If this can be taken as an indication of acquisition of bound variables (see Roeper 1986 for an alternative view), then the acquisition of the variable-binding property of QNPs may be very different from that of wh-questions, since the data available suggests that knowledge of the former is not clearly evidenced until after five (cf. Lee 1986).

[4]This position is adopted by Hornstein (1984), though he further assumes that the variable binding property may actually surface quite early.

[5]Aoun and Li (1987) have drawn attention to the fact that the English Double Object construction with QNPs as direct and indirect objects is scope unambiguous. For example, the sentence below cannot have the wide scope reading of QNP_2.

I gave a man every book.

The sentence cannot be understood as "For all y = book, there is a x = man such that I gave x y". Xu and Lee (1989) cite data such as the following which shows that the wide scope reading of QNP_2 in this kind of sentence may not be absolutely prohibited:

I sent an applicant every one of the department's brochures.

[6]S-structure and Logical Form refer to the levels of syntax standardly assumed in the Government Binding theory (cf. Chomsky 1981, van Riemsdijk and Williams 1986). For the purpose of our discussion, Logical Form can be broadly understood to be a level of representation one of whose identifying properties is that scope ambiguity is primarily represented structurally at that level (cf. May 1977, 1986).

[7]Alternatively, one could treat the preverbal PPs as merely superficial and analyze them as being on a par with NPs. Once this assumption is made, QNP_1 will c-command QNP_2. Acceptance

of this line of analysis will mean that it would be virtually impossible to find unequivocal cases of mutually commanding QNPs that do not show any c-commanding relationship.

[8]An alternative analysis of the *Ba*-construction in which the *Ba*-phrase is positioned as a sister to the verb may be proposed. This alternative is supported by the fact that not all verbs can appear in the *Ba* construction (e.g. stative verbs such as *zhidao* 'know' or *renwei* 'regard'), and clearly verbs need to subcategorize for this type of structure. The alternative analysis will not affect the relevance of the *Ba*-sentence to our experimental study.

[9]The *Ba*-construction can be seen as a structure allowing postverbal objects to be fronted to preverbal position following the subject. The scope properties of *Ba*-sentences are not well understood, though the adult control data of this study will provide some evidence for generalization. One of the salient properties of the *Ba*-construction is the requirement that the *Ba*-object be definite or specific. This seems to rule out at first sight the possibility of QNP_2 taking wide scope over QNP_1 (i.e. the *Ba*-object). We will return to this point in later sections.

[10]The experiment also tested the quantifier order in which an existential QNP precedes another existential QNP (EE order). The data on EE order will not be discussed in this paper, since these test sentences involve other quantificational properties in addition to relative scope, e.g. the tendency for universal generalization.

a. [yige laoshi jiao yige xuesheng] tai hao le
one-CL teacher teach one-CL student very good PRT
"It is fantastic that each teacher teaches one student"

b. (the fact) that for all x = teacher, there is a y = student such that x teaches y is fantastic.

[11]An interesting fact reported in Donaldson and McGarrigle (1974) is that sentences such as "All the cars are in the garages" were judged true by their children subjects only if each garage was occupied by a car. Likewise, sentences such as "All the books are in the boxes" were judged true only if the numbers of books and boxes were equal. They suggest that "for children under five, there is something peculiarly fundamental and compelling about the notion of fullness."

[12]An example of a response from a subject which cannot be classified as a scope-differentiated response is one where the subject placed only one of the objects (strings or towels) on another object (stool/doll) for the AE sentences. Similar non-scope responses were also observed among the younger subjects in Lee (1986).

[13]For some reason, 20% of the subjects gave at least one non-scope interpretation. This may be related to the fact that the sentence type violated lexical restrictions on the universal quantifier *mei* 'every'. Some adult subjects in fact reported that they found this sentence type very odd.

[14]An additional phrase structure constraint needs to be noted. It has been pointed out by Chen (1987) that generally in sentences of the form:

X V NP_1 [*zai* NP_2]

the NP_1 cannot be definite, as seen in the ill-formedness of

Fang neiben shu zai zhuo shang
put that-CL book at table on
"Put that book on (the) table"

The oddness of the V-sentences with AE order may also be related to the fact that universal quantifiers generally pattern with definite NPs, thus leading to violation of this phrase structure constraint.

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